Research stakeholder group

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Urbanization, globalization and climate change are major issues that affect and will affect the way we live. At the same time, they encourage us to create new solutions that can lead to a healthier and more sustainable urban life. Research and innovation (R&I) play a big role into this process, which combines technological, environmental, physical, economic and social aspects and calls for new mechanisms for adapting, applying and developing solutions. However, these challenges require increasingly coordinated strategies and actions, with the involvement of stakeholders at all levels, and cooperation within and amongst countries and across sectors and disciplines. R&I networks are essential in this context, not only to facilitate research development and knowledge exchange, but also to get a better understanding of the complexity of the challenges and of how to replicate solutions, coordinate priorities and, whenever possible, find a common voice in the dialogue with policy makers, consumers, industry and other key stakeholders.
What is the role of R&I to supporting the development of a smart city? Can researchers, and R&I networks, facilitate social participation? What is, and can be, the added value of R&I networks in the governance of smart cities? These are some of the questions addressed by this round table, which gathers the contribution of representatives of the largest energy research network in Europe, the European Energy Research Alliance (EERA).

Elena Guarneri *Smart grids, residential microgrids, smart home, sustainable mobility and e-mobility, big (open) data and IoT, building integrated PV, storage in PV systems and new grid architectures are some of the smart technologies which will support the transition towards smart cities. What would be the best way to integrate current research and innovation into processes that can limit the drastic increase in urban energy consumption and related CO_2 emissions?*

Luciano Martini Cities should pursue an integrated approach to significantly reduce their overall energy consumption, thus limiting their greenhouse gas emissions and other pollutants. Research and innovation (R&I) and the related generated know-how will allow cities to progressing towards their full sustainability. In this respect, there is the need to demonstrate innovative technologies, algorithms and tools for an optimized management of energy systems in cities, with mixed solutions that take into account sector coupling, weather and demand forecasting, market frameworks, prosumer interest and new business models, with the goal to maximize consumption of locally generated renewable energy.

R&I solutions to increasing the flexibility of the system in the short and long-term are key. This would allow minimizing the mismatch between load and supply profiles of alternative energy sources (electricity, heat, etc.) and in turn reducing the use of fossil fuels in peak load. Other concrete measures that would enhance the mass deployment of low-carbon technologies at city level are the labelling of city efficient buildings, according to their energy consumption, and the decarbonisation of the city transport sector through the full adoption of hybrid and battery electric vehicles (EVs). The lack of appropriate infrastructures is certainly slowing down the electrification of transport - other reasons are e.g. inappropriate business models. Solutions to foster the rollout of EVs in cities are needed to move towards a decarbonised transport sector - for example, having a number of real fast-charging infrastructures spread appropriately in the streets to allow users to be less dependent of battery capacities. Appropriate business models, as well as regulatory changes, should be proposed to make EV infrastructures deployment possible.

However, in many cases cities may have to prioritize their actions according to their particular needs and means, as it may not be manageable or be economically feasible to carry out actions in all areas of urban life at the same time and to the same extent. Hence, this may call for a certain prioritization in the efforts made by cities to tackle energy and transport challenges.

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Daniela Velte There is probably not a "unique" or "best" way to integrate research and innovation processes, since our cities differ largely in terms of untapped energy efficiency potential of the building stock, organization of mobility, cultural practices, capacity for social innovation and potential for the use of renewables. Each local solution probably requires the combination of all these factors to achieving a lasting effect on urban energy emissions.

Mathias Noe, Isabelle Johanna Südmeyer, Myriam E. Gil Bardají The deployment and system integration of energy technologies in Europe depend to a large extent on the strength of R&D efforts. A better design, planning and behavior aiming at greater energy efficiency gains are key elements to reducing the overall energy needs in Europe. For instance, by proposing new regulatory frameworks, business models, services and applications that enable a mass behavioral shift towards a proactive and sustainable relation of the prosumer to energy.

One of the key elements for the success of the energy transition is to raise the awareness and understanding of the public about the energy system of the future and the diversity of technologies and solutions (e.g. rural *versus* urban solutions, wind in the north, sun in the south, increase of e-mobility in cities, car sharing etc.).

The development of demonstration projects that are replicable and scalable, and that contribute to the overall system design at different community levels, is also a good option to integrate current research to reduce energy consumption, thus reducing emissions in general, and carbon in particular. Nevertheless, nowadays the demonstration of first of a kind real-scale technologies faces regulatory barriers. In addition to the support of technical innovation and demonstration, the proof of the practicability and commercial viability plays a very important role. Demonstration projects allow for gathering valuable knowledge about market applications and commercial arrangements for the energy system design: in fact, in these projects the complexity of the interface involving regulatory and commercial risks provides a sufficient route to push new technologies into commercialisation. In addition, new business models - such as shared mobility, seamless mobility and transactive mobility concepts - would also dramatically reduce the energy consumption in the transport sector.

Laurens de Vries A systemic approach is key. The EERA Joint Programme Energy System Integration (ESI) is working on improved modeling techniques for addressing problems that span different energy carriers, network levels and time frames. In addition, we need models that bridge the gap between technical and socio-economic models. In terms of research organization, I think more mission-based calls that explicitly embrace a multidisciplinary and innovative research approach would help.

Elena Guarneri *Smart Cities combine diverse technologies to reduce environmental impact and offer citizens better lives. This is not, however, simply a technical challenge. Making a city smart is a multidisciplinary challenge, bringing together city officials, innovative suppliers, national and EU policymakers, academics and civil society. Do Research and Innovation networks play a leading role to tackle this challenge?*

L.M. Yes, in smart cities the implementation of smart and integrated energy systems is not only a technological practice, but also a social, cultural, commercial and political practice where networks play an important role, since cooperation and coordination are pivotal ingredients.

Daniela Velte

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Laurens de Vries

(contribution on question 1)
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D.V. I don't see researchers leading the process of social participation. Their natural role is that of supporting engaged citizens and communities, who are the real drivers of social innovation.
M.N., I.J.S., M.E.G.B. The use of renewable energy sources, as well as the development of new concepts of circular economy and bioeconomy and interdisciplinary and societal factors, are all crucial elements to successfully implement the energy transition. Through the exchange of experiences and best practices of research and innovation, the development of the energy transition can be tackled not only in terms of technology but also of regulation and civil society. European countries can mutually learn R&I experiences and best practices, although a solution in one country is not directly transferrable to another. General public and civil society play a key role and R&I networks can support by seeding information and the understanding of the several R&I activities and novelties in the frame of the energy transition.
Research and Innovation networks play an important role at gathering the main actors of the energy landscape. At the moment there are many projects and platforms collecting research knowledge and experiences as well as end-user involvement - for instance, the BRIDGE project (www.bridgeproject.eu), which aims at building a system to support interoperability - both technical and social - in large-scale emergency management. The system will serve as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

Elena Guarneri *Do you think that Living Labs or incubator experiences could still play a key role to pave the pathways towards Smart Cities?*
L.M. Living labs could be seen as a variation of experimental Test Facilities, but with an important difference: they are completely exposed to external factors that could impact real-life performance. Thus, a living lab could still play a significant role towards smart cities since it could represent real-life operating conditions, failures, behavior and misuse of technical solutions in order to detect their intended impact, but also weaknesses, learnings and opportunities for improvement.
M.N., I.J.S., M.E.G.B. Current energy systems are operated and controlled with a focus on only one form of energy, such as electricity or heat. Future energy systems will be operated in highly integrated ways and must be controlled in smart ways in order to optimise the use of various forms of generation and storage technologies. Operation and control strategies for so-called hybrid energy systems currently exist only on a conceptual stage such as Living Labs.
Scientists in research facilities or in energy companies throughout Europe are collecting information in these test areas and feed them into their simulation software. However, every researcher uses his or her own simulation software, and no one knows exactly if different simulation methods fed with the same dataset come to comparable conclusions. Currently, various modelling tools and methods to simulate multi-energy systems with storage are under development (e.g. SmILES project, www.ecria-smiles.eu). In the SmILES project various application cases and test scenarios are being collected, simulated and compared by six project partners to find the best approach on how to integrate different types of energy and their storage systems into one energy grid. These cover different types of local systems, including urban neighborhoods, a rural village, office buildings, and a small industrial production site. Thus, there is much to learn from an exchange of experiences, and from better coordination of these approaches.

Elena Guarneri *Current governance structures in most countries usually require limited involvement of citizens in decision-making. The development of efficient and effective governments is a prerequisite for the development of smart cities. In which way R&I networks can represent an added value for governance?*
L.M. R&I networks could represent an added value for the city governance in many ways, for example by promoting and supporting the use of digital technologies to enable improved communication and engagement between citizens and Council, thus fostering the capacity for community and citizens to influence decision-making. In particular, the adoption of digital technologies and service platforms across the whole city could significantly improve Council planning, asset management and service delivery.
M.N., I.J.S., M.E.G.B. R&I networks are needed to bring together recent innovations and best practices of European smart cities solutions, so that a common understanding of R&I for smart cities across Europe is achieved while keeping the end-user in focus. New promising technological developments can be taken into consideration, evaluating the relevance in comparison to the existing targets. Still, experts from industry and research must certainly provide the expertise and propose the needed knowledge about new breakthrough technologies and developments. The R&I networks can help to seed and facilitate awareness raising towards the need for R&I activities, new technologies and understanding of CO_2.
For a fruitful long lasting framework for research and innovation exchange within these networks, the integration of national representatives of city councils, leading European research organizations together with end-users, is essential in order to avoid that industry and research organizations follow exclusively their own interests.

Elena Guarneri *Smart business models are needed for smart cities. Can you identify which innovative ones adequately support the transition towards smart cities?*

M.N., I.J.S., M.E.G.B. Renewable energy, energy efficiency, energy storage technologies and smart grid technology, as well as the interaction of these energy technologies, are the pillars of the energy transition concept. A few good examples of small to medium scale projects addressing smart business models for smart cities are:

- In Germany
  - The LAMP project, which connects 20 residential households in the area of Lazarettgarten in Landau and supports the trade of locally produced renewable energy among them. This pilot and research project is based on the Brooklyn Microgrid and a is one of a kind implementation of a local energy market in Germany. Therefore, LAMP is already trying out today the decentralized energy future of tomorrow
  - The research project RegEnKibo (Regionalisation of energy supply on the distribution grid level using the model location Kirchheimbolanden), which exemplarily models the electricity and gas network of Kirchheimbolanden based on real-time data, then validated and reconciled. The project partners use optimisation algorithms and take into account electricity from renewable energy sources fed into the medium and low-voltage levels.
- In Denmark: EnergyLab Nordhavn - New Urban Energy Infrastructures, which develops and demonstrates future energy solutions. The project uses Copenhagen's Nordhavn as a full-scale smart city energy lab and demonstrates how electricity and heating, energy-efficient buildings and electric transport can be integrated into an intelligent, flexible and optimized energy system.

Elena Guarneri *Which key stakeholders and key actions would better support - from a programmatic point of view - the transition to smart cities?*

L.M. Even though all stakeholders don't have the same relevance with regards to decision making, the effective transition to smart cities requires the involvement of all different stakeholders in a coordinated manner. Key stakeholders certainly include citizens and their community as well as research and innovation networks. In fact, demonstrators have shown that end-user behavior and interaction is at least of the same importance than technical aspects. Moreover, research and innovation networks could for example support the development of guidelines, methods and tools on collection, processing and storage of energy data in districts and cities to enable optimized planning, implementation, and monitoring of sustainable regional energy systems.

M.N., I.J.S., M.E.G.B. The energy transition involves changing policies, market design, regulatory frameworks and people consumption behaviours. It will profoundly affect the relation of every citizen to energy (e.g. the prosumers) and will require a profound transformation of behaviors and lifestyles. In that respect R&I networks (such as the European Energy Research Alliance, the European Technology and Innovation Platforms…) are essential to bring the main actors together and foster the exchange of key players and stakeholders.

In terms of stakeholders, a high level governance needs to be established including all relevant stakeholders, i.e.: national agencies, EU regulation experts, EU industry, TSOs and DSO (storage technologies, conversion technologies, transport…), representatives of EU networking platforms (e.g. ETIPs, EERA, EASE), city councils, citizens, consumers and end-users of multimodal forms of energy (electricity, gas, heat, fuels…), public transport stakeholders. With regards to actions, it is key to:

- Establish a sufficient grid infrastructure not only for electricity, but also for gas and heat, where reasonable
- Establish sufficient individually adapted storage capacities
- Foster balancing energy consumption
- Increase clean mobility options for urban areas as well as for long-distance travel and transportation (e. g. sharing transport)
- Scale-up technologies, including the reduction of materials consumption
- Implement the Circular Economy Strategy at all stages
- Develop innovation laboratories for citizen-inspired technology development (combining demand pull and technology push)
- Support education and training.